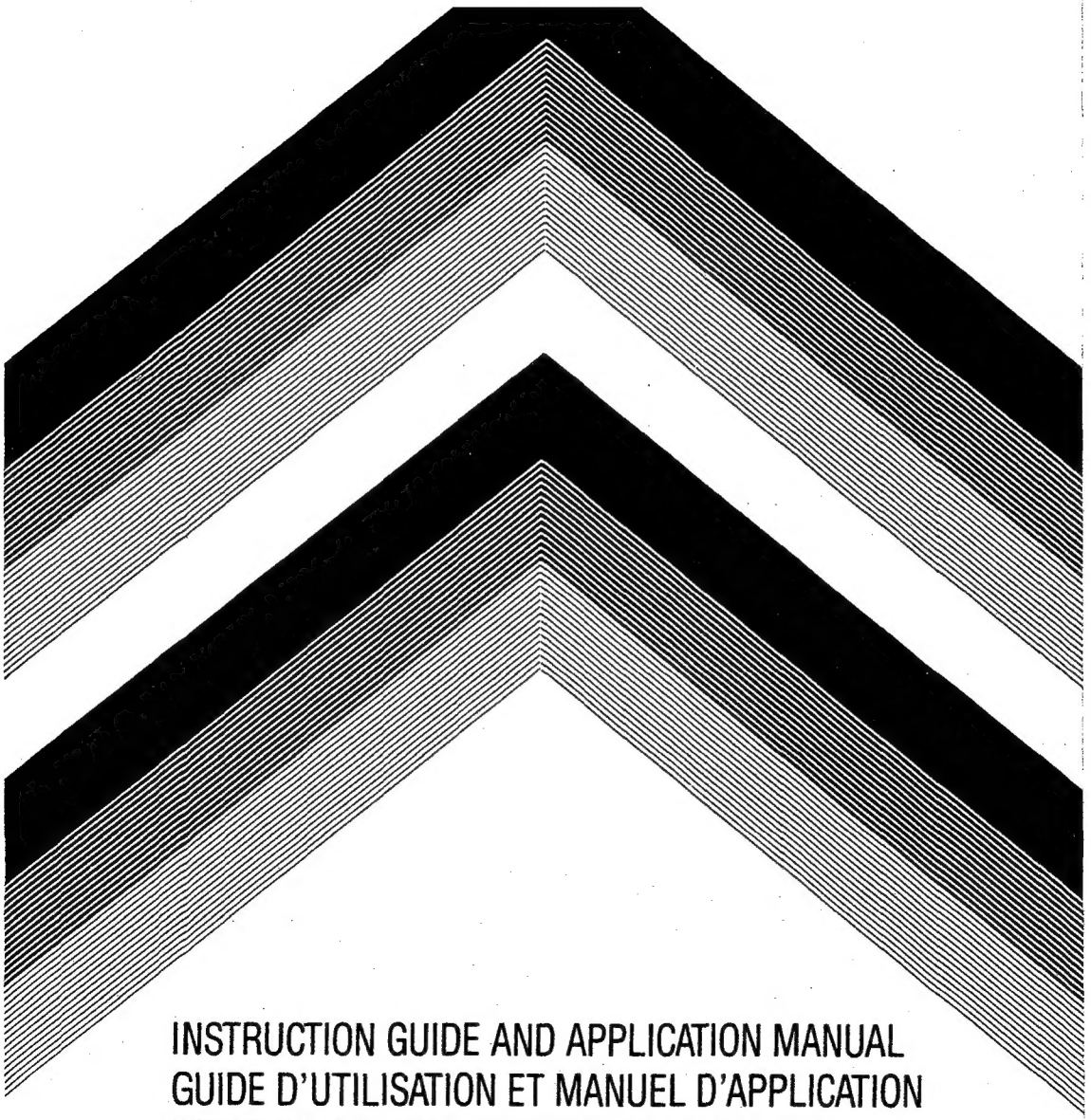
SHARP®

EL-735

BUSINESS/FINANCIAL CALCULATOR
CALCULATRICE COMMERCIALE/FINANCIÈRE
BUSINESS/FINANZ-RECHNER
CALCOLATRICE COMMERCIALE/FINANZIARIA



INSTRUCTION GUIDE AND APPLICATION MANUAL
GUIDE D'UTILISATION ET MANUEL D'APPLICATION
BEDIENUNGS- UND ANWENDUNGSANLEITUNG
MANUALE D'ISTRUZIONI E GUIDA APPLICATIVA

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ENGLISH

EL-735
BUSINESS/FINANCIAL CALCULATOR
INSTRUCTION GUIDE
AND
APPLICATION MANUAL

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The SHARP EL-735 Business/Financial Calculator

Whether you are in business, financial analysis, banking, marketing or statistics, you will find the SHARP EL-735 Business/Financial Calculator a valuable addition to the tools of your trade. This calculator is a new computing instrument that will provide formidable computing power in all types of business and financial applications.

To solve interest, future value, amortization, cash flow, and many other problems, it is not necessary to input complex programs. Keys are provided which allow you to directly perform those calculations. Also convenient calendar and database functions have been added to this calculator to help simplify time calculations and data storage. This manual covers many areas in an attempt to service the broadest spectrum of EL-735 users. User comments and suggestions are always welcome.

Introduction

This first chapter covers the basic functions of the SHARP EL-735 calculator including entering numbers, correcting errors, arithmetic calculations, percentage calculations (the [CST], [SEL], [MAR], and [MU] keys) and the other general math functions (such as [e^x], [ln], [$n!$], [y^x], [$1/x$], [$\sqrt{\ }$], and [x^2]). This is important background information, and provides a good introduction to the EL-735.

The keys

Every key on the EL-735 has a function printed on it and many keys have other functions printed above them. The functions on the face of the key are called the primary functions and the functions printed above the key are called the secondary functions (abbreviated as 2ndF).

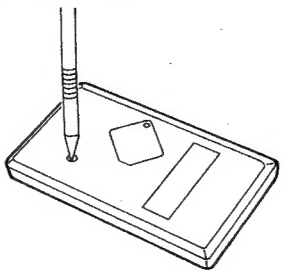
Turning on and off

To turn the EL-735 on, press the [ON] key. When the EL-735 is off, this key serves as the [ON] key. When the EL-735 is on, this key functions as a [BREAK] key and provides a break (and intermediate result) in long calculations.

The [OFF] key is used to turn the calculator off. The EL-735 has an auto power off feature and will turn itself off to protect the batteries if no keys are pressed for several minutes, the memory will be safeguarded.

The reset switch

All data stored in the calculator can be deleted by pressing the reset button on the back of the calculator. Press this button gently using a strong blunt object like a ballpoint pen. Don't use a pencil as the lead may break. Resetting the calculator de-



letes all stored data, including the contents of the memory and registers.

The indicators

Various indicators may appear in the display, for example, the "M" indicator will appear in the left of the display if a number other than zero is stored in the calculator's memory. The other indicators that appear in the display will be discussed later, in their appropriate sections.

Entering numbers

To enter a number into the display, simply press the keys that represent the digits of that number. For example, to enter the number 1.226, press [1] [•] [2] [2] [6].

Changing the sign of a number

To change a number from positive to negative, or vice versa, press the [+/−] key. Pressing [+/−] with the number 1.226 in the display will change the display to −1.226. Press [+/−] again, and the display will change back to 1.226.

Adjusting the decimal places

The [2nd F] [TAB] keys are used to adjust the number of displayed decimal places. For the above example, press [=] to finish entering the number (1.226), then press [2nd F] [TAB] [3]. The EL-735 will display all three decimal places. Press [2nd F] [TAB] [2] and 1.23 will be displayed.

The EL-735 rounds the number in the display to the specified display format, however this rounding takes place only in the display. The number stored and used in calculations contains all digits (up to 10 digits). Having rounding occur only in the display minimizes rounding errors in calculations.

Pressing [2nd F] [TAB] [•] sets the calculator to display all digits after the decimal point, except for trailing zeros. If 4.250000000 [=] is entered the display will show 4.25, whereas if 4.250000001 [=] is entered the display will show 4.250000001.

Digit grouping

As the EL-735 is sold to an international market, digits in numbers over one thousand are grouped using an apostrophe in the display (rather than a comma or period). As an example, enter the number 1234567890, it will be displayed as 1'234'567'890.

Scientific notation

Any number equal to or greater than 10'000'000'000 is represented in scientific notation. For example, the number 150'000'000'000 is displayed as 1.5 11, this means 1.5 times ten to the eleventh power (1.5×10^{11}).

To enter large numbers in scientific notation, enter the power of ten first using the [y^x] key, then multiply by the mantissa. For example, to enter 200'000'000'000, press 10 [2nd F] [y^x] 11 [×] 2.0 [=].

Correcting errors

Two keys are provided for correcting errors in the display. The [→] key backspaces over incorrect digits in the number currently being entered, and the [C·CE] key clears the number in the display. As an example, enter the number 6.22895, then use the [→] key to change the 8 to a 5. Once you have 6.22595 in the display, press the [C·CE] key to clear the display back to zero.

Clearing the display

If the [C·CE] key is pressed once, the last number entered is cleared from the display. For example, enter 5 + 6 then press the [C·CE] key, the 6 is cleared and the 5 reap-

pears in the display. Pressing [C·CE] again clears the calculation completely.

The secondary function of the [C·CE] key is the clear all (CA) function which clears all the registers associated with that mode and saves only the M register and database/CFi memory.

Occasionally, a key may be pressed that does not make sense to the calculator (for example, dividing by zero). An "E" will appear in the lower left of the display indicating that an error occurred. To clear this error and continue working, press [C·CE].

Calculation modes

The EL-735 has two calculation modes: Financial mode, and Statistics mode.

The mode of the EL-735 dictates which functions are immediately available. For a financial problem, it is most likely that the EL-735 should be in the Financial mode. Likewise, statistics problems generally require the calculator to be in the Statistics mode.

To change modes, simply press the [2nd F] [STAT] keys ([STAT] is the secondary function of the [►] key). The EL-735 toggles between the Financial mode and the Statistics mode each time the [2nd F] [STAT] keys are pressed. The "STAT" indicator appears in the display when the EL-735 is in the Statistics mode.

Before continuing, press the [2nd F] [STAT] keys until "STAT" does not appear in the display, indicating that the EL-735 is in the Financial mode.

The [2nd F] key

If the [2nd F] key is pressed the "2nd F" indicator appears in the display. When this indicator is on, keys with secondary functions take on their secondary meanings (if the secondary functions are active in the current mode). Pressing [2nd F] again removes the "2nd F" indicator from the display and restores the primary function to the keys.

Arithmetic

Most people have had at least some experience at using the four basic arithmetic functions [+], [−], [×], and [÷]. Arithmetic problems are entered as they would be read. It is also possible to chain several calculations together as shown in the examples below. All the arithmetic functions are completed in the order of entry, except when parenthesis (brackets) are used to specify the order of execution.

For the following examples, set the EL-735 display to four decimal places before starting, press [2nd F] [TAB] [4].

Example:
(993.7 + 688.3) ÷ 21.0
Enter:
993.7 [+] 688.3 [÷] 21 [=] Result: 80.0952

Example:
8 × (2265 − 1104)
Enter:
2265 [−] 1104 [×] 8 [=] Result: 9'288.0000

Memory

The EL-735 has five registers available for normal use. These registers are called M, CST, SEL, MAR, and MU. Other memory and registers are also available for use in Financial calculations, these are described later. Treat the registers as boxes that can each hold one number.

Numbers stored in these registers are saved, even when the calculator is turned off.

The M register

The three keys to use the M register are the [x→M], [RM], and [M+] keys. The M register can be used in normal calculations, to temporarily store results, or, to save an important number when the calculator is turned off.
The M register is active in the Financial mode, it is not active in the Statistics mode.

Storing a number in the M register

To store a displayed number in the M register, press [x→M]. The new number will replace any number that was stored in the M register. When a number other than zero is stored in the M register, the "M" indicator appears in the left of the display.

Example:
Store the number 75.2989 in the M register.
Enter:
75.2989 [x→M]
Notice that the "M" indicator now appears in the left of the display.

Recalling a number from the M register

Turn the calculator off, then turn it back on. The display is cleared, but the "M" memory indicator is still displayed. Press [RM] to recall the number from memory (the number 75.2989 will appear in the display). After pressing [RM], the "M" indicator will still be displayed to show that 75.2989 is still stored in the M register.

Using a stored number in calculations

To use the number stored in M in calculations, press [RM] at the point in the calculation where it would otherwise be necessary to enter the number.

Example:
99.2115 – 75.2989
Enter:
99.2115 [−] [RM] [=] Result: 23.9126

Recalling the number from the M register does not change the number. The stored number will not change until a new number is stored in the M register, or the stored number is altered using the [M+] key.

Using the [M+] key to add to the number in memory
To add a number to the number in the M register, press the [M+] key. The sum of the displayed number and the M register will be the new number in the M register.

Example:
Add 25 to 75.2989 in the M register, subtract 0.2989 from the new number, and then recall the final number to the display.
Enter:
25 [M+] Display: 25.0000

.2989 [+/−] [M+] Display: −0.2989

[RM] Result: 100.0000

Clearing memory
To clear the M register, press 0 [x→M], or press [RM] [+/−] [M+]. The "M" indicator in the display will disappear.

The rest of this chapter contains useful examples of normal calculations. Work through any examples that may be suitable. Feel free to attempt examples without looking at the given solution, coming up with the result unassisted speeds up the learning process.

Balancing the cheque-book

One financial calculation procedure that most people face regularly is the challenge of reconciling a bank's monthly statement of a cheque account with personal records of that account. Most people view this process as troublesome and try to avoid it one way or another. Other people enjoy taking a few minutes to verify their wealth (or lack thereof) on a monthly basis.

Also, the recent development of Automatic Teller Machines now allows cash withdrawals directly from accounts without having to write a cheque. The convenience is great, but is often at the expense of accurate record keeping. Cash withdrawals can go unrecorded (especially when more than one person uses the same account), making the monthly reconciliation even more important.

The exact procedure for balancing the cheque-book can vary greatly and people often use standard forms provided by their banks. Whichever procedure is used, the SHARP EL-735 can be a great help.

The following six point procedure is only one method that might be used to balance a cheque account. The way the M register is used in the example may be useful in other account balancing procedures. This procedure assumes the following:

- That the bank statement provides a list of cheques in order of cheque number (most statements provide this).
- That a break in the sequence of cheque numbers in the list of cheques is indicated with an asterisk (or by some other means).
- That a written register has been kept of the cheque deposits and withdrawals for the account.

The six point procedure for reconciling bank statements with cheque account registers is as follows:

1. Note the statement date and the last cheque number that appears on the statement.
2. Draw a line in the cheque register under the last cheque to appear on the last statement, and compute the register balance to that line (if it hasn't been done already). This will become the start balance.
3. Add any deposits that appear below the line in the register and that occurred before the statement date (they should also appear on the statement).
4. Subtract any cash withdrawals that appear below the line in the register and that occurred before the statement date.
5. Mark any cheques (with a ✓ or ×) that appear above the line in the register and don't show on the statement (and haven't shown on previous statements). The quickest way to find these outstanding cheques is to note breaks in sequence in the list of numbered cheques on the statement. Add the amounts of these outstanding cheques.
6. Add any interest earned on the account and subtract any service charges. Record interest earned and/or service charged in the register (after the last entry).

The number arrived at using the above procedure should exactly match the closing balance on the statement.

Example:
The closing balance on a statement dated June 1, 1989 is $977.39 and the last cheque number on the statement is 1612. The calculated balance up to cheque number 1612 in the register is 907.93. Also, one $40.00 cash withdrawal on May 26 appears in the register after check 1612.

There are six cheques missing from the sequence of numbered cheques on the statement, but three of those occur at the beginning of the list, so assume that they are not outstanding. The three outstanding cheques are for the amounts $26.22, $65.00, and $11.75 (according to the register). There is $6.49 in interest on this statement. Does the register match the statement?

Explanation:
This calculation can be done either by using the memory or by using a chain calculation. The memory solution is described first, then the chain calculation is shown. The results are shown with [2nd F] [TAB] [2] decimal notation.
First store the balance from the cheque register (after cheque 1612) into M.
Enter:
907.93 [x→M].
Subtract the $40 withdrawal that occurred after cheque 1612 but before the statement date.
Enter:
40 [+/−] [M+].
Add the three outstanding cheques.
Enter:
26.22 [M+] 65 [M+] 11.75 [M+].
Add the interest earned.
Enter:
6.49 [M+].
Finally, recall the result.
Enter:
Press [RM]. Display: 977.39
The result is $977.39, so the register matches the statement exactly.
Alternately, perform the chain calculation.
Enter:
907.93 [−] 40 [+] 26.22 [+] 65 [+] 11.75 [+] 6.49
[=]. Display: 977.39
This actually takes less keystrokes.

Percent calculations

Two percent calculation keys are provided on the EL-735: [%] (percent) and [Δ%] (percent difference). These functions are handy for calculating percent and percent increases and decreases.

Example:
7% of 66?
Enter:
66 [×] 7 [2nd F] [%] Result: 4.62

Example:
24.99 + 6%
Enter:
24.99 [+] 6 [2nd F] [%] Result: 26.49

Example:
Reduce 24'000 by 16%.
Enter:
24000 [−] 16 [2nd F] [%] Result: 20'160.00

Generally the [%] key is used in conjunction with the [+], [−] or [×] keys. It can also be used in conjunction with the [÷] key (where it is essentially the same as pressing [×] 100 [=]).
Example:
What is 6'599'975'227 ÷ 4%?
Enter:
6599975227 [÷] 4 [2nd F] [%] Result: 1.65 11
(scientific notation)

The [Δ%] key is always used in conjunction with the [−] key. To find the percent increase or decrease between two numbers, start the calculation as if finding the difference (subtracting), but instead of pressing the [=] key to complete the calculation, press [2nd F] [Δ%].

Example:
Sales in a company were $75'000.00 during the first year of operation. The second year sales were $116'000.00. Second year sales were what percentage greater than first year sales?

Solution:
116000 [−] 75000 [2nd F] [Δ%] Result: 54.67

This result shows that second year sales have a 54.67% percent increase over the first year sales. The percent difference is calculated with the first year sales as the base for the percent calculation.

If the result of this operation in negative (−), then there has been a percent decrease between the two numbers entered.

Markups and margins
The [CST], [SEL], [MAR] and [MU] keys on the EL-735 also have very useful functions. Each one of these keys represents a memory register in the EL-735. It is possible to store any number in these registers in the Financial mode. Each register can hold one number.

MU:	Markup
MAR:	Margin
SEL:	Selling price
CST:	Cost price

However, the true utility of these keys is not just that they can store numbers for later use, but that the numbers in these registers have a special meaning to the calculator. The main function of these keys is to allow some powerful business percent calculations.

For the following examples the EL-735 should be in the Financial mode, and the display should be set to [2nd F] [TAB] [2].

Example:
In a furniture business, it is considered desirable to realize a 95% markup from cost to retail price for each item. A certain sofa costs $455.70. What should be its selling price?
Enter:
95 [MU] 455.70 [CST] [COMP] [SEL] Result: 888.62

In the above solution, the markup is stored in the MU register by pressing 95 [MU]. Then the cost is stored in the CST register (455.70 [CST]) and the selling price is computed by pressing [COMP] [SEL]. (The [COMP] key always means "compute.")

Example:
What is the margin on each sofa sold?
Enter:
[COMP] [MAR] Result: 48.72

Example:
In the same furniture business, the cost of a 2m × 3m oriental rug is $502.40. Using the same markup and margin, what is the selling price?
Enter:
502.40 [CST] [COMP] [SEL] Results: 979.68
Notice that once a number is stored in one of these four registers, it only changes if a new number is stored or if a new value is computed (or if you press [2nd F] [CA], which clears all registers except M).

After completing the examples, the numbers in the four registers are as shown below:

MU:	95.00	Markup
MAR:	48.72	Margin
SEL:	979.68	Selling price
CST:	502.40	Cost price

To verify that the registers contain these numbers, use the recall function. Press [RCL] [CST] to display 502.40, [RCL] [SEL] to display 979.68, [RCL] [MAR] to display 48.72, and [RCL] [MU] to display 95.00.

It is possible to use the numbers stored in these registers in calculations just like numbers stored in the M register, except no arithmetic register keys (such as [M+]) are available.

Mathematic functions

Seven mathematic functions are available on the EL-735 and the use of these functions is fairly straightforward. These seven functions are available in both calculation modes. All of the functions, except for [y^x], operate on the number in the display. With [y^x], you need to enter one number (y), press [y^x], enter another number (x), and then press [=].

For the following examples, the EL-735 must be in the Financial mode with the display set to [2nd F] [TAB] [2].

Example:
What is the inverse of 9?
Enter:
9 [2nd F] [1/x] Result: 0.11

Example:
What is the square root of 289?
Enter:
289 [2nd F] [$\sqrt{\ }$] Result: 17.00

Example:
What is 2^5 (two to the fifth power)?
Enter:
2 [2nd F] [y^x] 5 [=] Result: 32.00

Example:
What is the cube root of 755?
The key to solving this type of problem (a root other than the square root) is that the nth root of a number is equal to that number raised to the 1/n power. In this case, raise 755 to the 1/3 power in order to calculate the cube (or third) root.
Enter:
755 [2nd F] [y^x] 3 [2nd F] [1/x] [=] Result: 9.11
To verify this result, raise the result back to the third power by pressing [2nd F] [y^x] 3 [=]. This will give 755.00.

Example:
What is 275^2 (275 squared)?
Enter:
275 [2nd F] [x^2] Result: 75'625.00

Example:
What is 6! (six factorial=$1 \times 2 \times 3 \times 4 \times 5 \times 6$)?
Enter:
6 [2nd F] [$n!$] Result: 720.00

Example:
What is $e^{0.226}$?
Enter:
.226 [2nd F] [e^x] Result: 1.25

Example:
What is the natural log of 422?
Enter:
422 [2nd F] [ln] Result: 6.05

Arithmetic with constants

The EL-735 is equipped with a built-in constant feature that allows repetitive calculations. It is possible to perform the same function with the same number without having to re-enter that number and function. Try the following examples.

Enter:

10 [+] 20 [=] Result: 30.00

20 is now a constant for further additions.

Enter:

60 [=] Result: 80.00

Subtraction is similar.

Enter:

100 [−] 25 [=] Result: 75.00

Enter:

40 [=] Result: 15.00

For multiplication, the first number entered is the constant.

Enter:

3 [×] 5 [=] Result: 15.00

Enter:

10 [=] Result: 30.00

For division, the second number entered is the constant.

Enter:

15 [÷] 3 [=] Result: 5.00

Enter:

30 [=] Result: 10.00

Days and date calculations

The EL-735 can perform calculations on dates and the number of days. The [2nd F] [360/ACT] keys can be used to toggle between a 360 day calendar (12 months of 30 days) or the actual calendar (with 365 days, and leap years included). The "360" indicator appears in the display when the 360 day calendar is active. The range of calculations is from January. 1, 1901 to December. 31, 2099.

Days calculations

Days calculations determine the number of days between the initial and closing dates using either 360 or actual calendars.

MM.DDYYYY [DATE1] MM.DDYYYY [DATE2] [COMP] [DAYS] ➡ No. of days

↑ Initial date

↑ Final date

Date calculation

Date calculations allow determination of a date which is a specified number of days before or after a given date on the actual calendar.

Select the actual calendar with [2nd F] [360/ACT] ("360" disappears from the display).

MM.DDYYYY [DATE1] No. of days [DAYS] [COMP] [DATE2] ➡ Final date

↑ Initial date

MM.DDYYYY [DATE2] No. of days [DAYS] [COMP] [DATE1] ➡ Initial date

↑ Final date

When a date is entered for DATE1 or DATE2, the day-of-the-week for that date is displayed.

Note:

When the 360 days calendar is selected, pressing [COMP] [DATE1] or [COMP] [DATE2] will result in an error.
The contents of the DATE1, DATE2, and DAYS registers are retained as long as the [2nd F] [CA] keys or reset switch are not pressed.
Date information assigned to DATE1 or DATE2 cannot be used for general calculations, any such attempt will result in an error.
Date information cannot be assigned to CFi memory or Financial registers (n, i, PV, etc.). It can only be entered to the DATE1 and DATE2 memories or database.

Example:
Calculate the number of days between December 25, 1987 and August 10, 1988. The EL-735 must not be in the 360 submode. Set the display to [2nd F] [TAB] [.].
Enter:
[2nd F] [CA]
12.251987 [DATE1] (Friday)
8.101988 [DATE2] (Wednesday)
[COMP] [DAYS] Result: 229.
(If the 360 day calendar is selected, the answer would be 225 days.)

Example:
Calculate which date is 100 days after November 13, 1987.
Enter:
[2nd F] [CA]
11.131987 [DATE1] (Friday)
100 [DAYS]
[COMP] [DATE2] Result: 2-21-1988 (Sunday)

At this point this manual has covered the basic functions of the EL-735 Business/Financial calculator.

Financial Calculations

In the Financial mode all the financial and arithmetic functions are active, but the statistics functions are inactive.

The Financial mode has access to many registers including the independently accessible register M, the special financial registers: n, i, PV, PMT, FV, CST, SEL, MAR, MU, DATE1, DATE2 and DAYS (12 registers), plus the CFi (cash flow) memory. The cash flow memory shares the same memory location as the Financial database, and if the database is not used, up to 70 CFi memories are available.

This powerful collection of registers and memory will allow the user to perform many powerful Business and Financial calculations.

Storing numbers

The primary purpose of the registers and memory is to aid financial calculations. However, let's first take a look at how to use these registers for storing and recalling numbers.

To store a number in one of the registers, for example the FV register, enter the number and press [FV]. To recall a number from one of the registers, press [RCL] and then press the key that names the register ([n], [i], [PV], [FV], etc).

As long as the EL-735 is in the Financial mode, the numbers in all active registers will be saved, even when the EL-735 is turned off. Numbers will only be changed by storing or calculating a new number in that register, or clearing the registers by pressing [2nd F] [CA].

Interest

A financial calculation is generally a calculation that involves money and time. Money accumulates interest as time passes, and given a known situation, it is possible (with the EL-735) to determine the unknowns that may arise.

There are two types of interest, simple and compound. Compound interest is the most common in these modern times, and it is the type of interest that the EL-735 financial functions are based upon. Simple interest is rare and is not mathematically complicated, so there is no need for special functions to handle it.

Simple interest

Because simple interest is rarely used anymore (except perhaps on personal loans from relatives), it is not covered extensively in this book. However, simple interest is closely related to compound interest and is worth a brief examination.

To borrow $1'000 for three years at 15% simple interest, at the end of those three years it would be necessary to pay back $1'150 (150 is 15% of 1000). Generally, simple interest is not time dependent. The term and the amount of interest are negotiated and set at the beginning of the contract.

But simple interest is not very flexible. What if one year later $250 of the $1'000 loan is paid back? Shouldn't that reduce the amount of interest paid? Things like early payments introduce a time dependence. The amount of interest owed depends on the amount of time the money is held.

Compound interest

Compound interest accumulates at a predefined rate on a periodic basis. Money deposited in a passbook savings account at a bank, accumulates a certain amount of interest each month, increasing the account balance. The amount of interest received each month depends on the balance of the account during that month including interest added in previous months. Interest earns interest, that is why it's called "compound" interest.

Compound interest is time dependent. To borrow from a well-worn phrase: time is money.

It is important to know the compounding period of a loan or investment before starting, because the whole calculation is based on it. The compounding period is usually specified or assumed (often it's monthly).

Once the compounding period of a loan or investment is known, it is also necessary to know that the compounding period has only one interest rate associated with it. (It is not necessary to know the rate, it can be the unknown). The interest rate combined with the compounding period causes money to change in value at the end of each period.

Financial functions and terms

The EL-735 has two main groups of financial functions: the Time Value of Money (TVM) functions and the Discount Cash Flow (DCF) analysis functions.

Recognizing a TVM problem

The primary TVM functions are listed below:

[n] Number of periods

[i] Interest rate per period

PV Present value

PMT Payment

FV Future value

Other functions are provided for amortization and interest conversions, but these functions are covered later.

Financial problems that work with the TVM functions usually have a cash flow at the beginning of the time (called the PV or present value), a cash flow at the end of the time (the FV or future value), and a stream of regular periodic payments (PMT), all of the same amount, in between. Typically; mortgages, loans, leases, savings, annuities, and contracts with regular payments can be analyzed using the TVM functions.

Recognizing a discounted cash flow problem

Four functions on the EL-735 deal with discounted cash flow analysis. These DCF functions are listed below:

CF*i* Cash flow group i (where i can be 0, 1, 2, etc.)

N*i* Number of cash flows in group i

NPV Net present value

IRR Internal rate of return

By using the DCF functions, just about any investment situation can be described and analyzed. As long as the periods are regular and interest compounds once per period, these functions will be extremely effective.

TVM applications

In working a TVM problem, it is necessary to translate the financial language used to the simple language of the five TVM keys.

Payments at the end of the period

The EL-735 can be set to solve TVM problems with payments at either the beginning or the end of the cash flow period. The reason that this is mentioned here is because if the EL-735 is set to BGN mode, it will not be possible to get the right answer in this example. The BGN/END key is used to switch the EL-735 in and out of BGN mode. When the "BGN" indicator is displayed, the EL-735 is set to solve TVM problems with payments occurring at the beginning of the period.

Why should it make a difference if the payments occur at the beginning or end of the period? Basically, the quicker the balance is reduced, the less interest will accumulate and the smaller the payment will be.

So in this problem, be aware that the EL-735 should not be in BGN mode.

Example:

A realtor has a chance to sell a $106'000.00 house. The buyer can come up with about $12'000.00 dollars as a down payment, leaving about $94'000.00 to finance. The interest rate is hovering at around 10.5% APR. The term of a typical mortgage is 30 years. What will be the payment on this loan?

Explanation:

First, is the period monthly; where was that stated? Second, what is an APR, and does it need to be divided by 12?

The answer to the first question is that the period should be stated in the description of the problem.

However, usually if the period isn't explicitly stated in a description, assume it is monthly. In fact, the monthly period is so common that the function [2nd F] [×12] is provided above the [n] key on the EL-735 to speed up the conversion of years into months.

The answer to the second question is that lending institutions (most banks and finance companies) usually quote interest as a "nominal APR (annual percentage rate)." They take the periodic rate used in their calculations and multiply it by the number of periods in a year (usually 12). So usually the first thing to do, given an APR with monthly compounding, is to divide it by 12. Notice that the [2nd F] [÷12] function is provided above the [i] key for this purpose. Pressing the [2nd F] [×12] or [2nd F] [÷12] keys stores the result automatically into the n or i registers.

The periodic rate is the only one that makes any sense to the EL-735. Also, along with the nominal APR that they divide by 12 and use in their calculations, most lenders are required to quote the effective APR or true APR, which is a calculated annual rate that includes compounding (and finance charges). Calculating effective rates is covered later.

The amount financed is $94'000 (PV=94'000) to be completely paid off (FV=0) over a period of 30 years (or 360 months) at a periodic interest rate of 0.875% per month. Set the display to [2nd F] [TAB] [2].

Enter:
106000 [−] 12000 [=] [PV]
10.5 [2nd F] [÷12]
30 [2nd F] [×12]
0 [FV]
[COMP] [PMT] Result: −859.85

Example:
Refer to the last example, the buyer says that an affordable payment on the mortgage loan (which doesn't include taxes and insurance) would be around $800.00. What does the price of the house have to be to reduce the payment from $859.85 to 800.00?

Explanation:
Now the payment is known (PMT is −800.00) and a new present value (PV) needs to be calculated. To this new PV, add the amount of the down payment to arrive at the desired price of the house.

Enter:
800 [+/−] [PMT] [COMP] [PV]
[+] 12000 [=] Result: 99'456.61

Once a TVM situation is entered in the EL-735, it is not necessary to re-enter everything to see how one change affects another value. For questions like, "What if the payment changes to 800.00; how does that affect the PV?" and, "What if the interest rate changes to 11.2% APR; how does that affect the payment?", the answers are just a few keystrokes away.

Balloon payments and FV calculations

The future value FV is an amount left at the end of the cash flow that is separate from any regular payment that may occur at that point. A balloon payment is a payment at the end of a loan contract that completely pays off the remaining balance. It is important to recognize that the FV may have to be added to a regular payment amount to determine the actual final payment amount for the loan.

Example:
A buyer wishes to purchase a house with a 15 year mortgage for $97'000.00 at an interest rate of 11.5% APR. However the buyer has only a five year employment contract, so a balloon payment is scheduled at the end of those five years to pay off the balance of the loan. What is the mortgage portion of the house payment (not including taxes and insurance) and what is the amount of the balloon payment?

Explanation:
The first part of this solution is a payment calculation.

Enter:
15 [2nd F] [×12]
11.5 [2nd F] [÷12]
97000 [PV]
0 [FV]
[COMP] [PMT] Result: −1'133.14

Once the payment is calculated, the FV calculation is just a matter of changing n to 60 (5 years × 12 months) and calculating FV.

Enter:
5 [2nd F] [×12] [COMP] [FV] Result: −80'596.08

This is the amount left to pay on the loan after the 60th payment. However, the actual final balloon payment is going to include the last regular monthly payment. So to calculate the final balloon payment:

Enter:
[RCL] [PMT] [+]
[RCL] [FV] [=] Result: −81'729.22

Remember that money paid out is always negative, this is the convention used by the EL-735.

The BGN submode

To put the EL-735 in the BGN submode, press the [2nd F] [BGN/END] keys. The "BGN" indicator should appear in the display to indicate the EL-735 is set to the BGN submode. When set to BGN, the EL-735 assumes that payments (PMT) in TVM problems occur at the beginning of the period rather than at the end. BGN only affects TVM functions and does not have any affect on the DCF functions.

Payments at the beginning of the period are called "payments in advance" or "annuity in advance." Payments at the end of the period are sometimes called "payments in arrears" or "annuity in arrears."

Leases

In leases of property or equipment, it is common to have the payments at the beginning of the period. A lease is a loan of something with material value in exchange for periodic payments. It is possible to lease a car, equipment for business, a house, or any other real property.

Lease contracts vary considerably depending on what is being leased and the intentions of the parties involved in the lease. Leases that require payments up front (for example, the last three payments up front, or the first year's payments up front), or that have some other variation to steady, even payments, may require some manipulation before they can be solved using the TVM functions. Leases that get overly complex often must be calculated using the DCF functions.

To solve the following example, the EL-735 must be set to BGN (the "BGN" indicator appears), and the display set to [2nd F] [TAB] [2].

Example:
The president of a company is negotiating a five-year lease on a prospective new building. The building is valued at $775'000.00, and is in an area that will allow good growth, so the president is negotiating an option to buy at the end of the lease. After negotiation, the owner settles on a buy-out price of $700'000.00. The owner wants to see about a 12% yield on the value of the building during the five-year lease. What are the monthly payments?

The first payment occurs at the beginning of occupancy so this calculation requires BGN.
Enter:
[2nd F] [BGN/END] (to display BGN)
775000 [PV]
5 [2nd F] [×12]
1 [i]
700000 [+/−] [FV]
[COMP] [PMT] Result: −8'582.51

The order of input for the values n, i, PV, PMT, and FV is not important as these keys only store a number in a register. Only when one of these keys is preceded by [COMP] does the EL-735 do any computing. When one of the five TVM values is computed, the EL-735 bases the answer on the numbers stored in the other four TVM registers.

Interest rate calculations

The interest rate on a loan or investment with a regular payment can be calculated by pressing [COMP] [i]. If the cash flows are irregular or uneven, the DCF function IRR (described later) is generally required for the solution.

The [i] key always computes a periodic rate. To get the APR, multiply the result by the number of periods in a year (12 for monthly periods, 4 for quarterly periods, etc.).

Example:
A prospective buyer wishes to buy a $75'000 properly with a $5'000 down payment and the ability to pay taxes, insurance, plus $700 dollars a month. Is it likely that this person will be able to find the financing to purchase?

Make sure the EL-735 is not in the BGN submode.

Enter:
30 [2nd F] [×12] 0 [FV]
70000 [+/−] [PV]
700 [PMT]
[COMP] [i] Result: 0.97

This is a monthly rate, multiply by 12 to get a nominal APR of 11.63%. At the time of writing, this is a reasonable rate on a mortgage (perhaps even a little high) so the prospective buyer would be likely to get financing.

Effective interest rates
Interest rate terminology can be confusing. There are "periodic rates," "nominal APRs," "actual APRs," "effective rates," "actual effective rates," "variable rates," "ended rates," "coupons," "yields," "returns," "finance charges," and many other terms that depend upon the field of finance being discussed.

Always keep in mind that the most important rate to know for financial calculations is the periodic rate. This is the rate that regulates how money grows from one period to the next. The other rates that are quoted are always calculated from the periodic rates.

One common way to quote an APR (annual percentage rate) is to multiply the periodic rate by the number of periods in a year. But this "nominal APR" is just a convenient approximation, it does not incorporate compounding, which can be significant at higher interest rates.

The effective rate is an annual percentage rate that incorporates compounding. Two functions on the EL-735 allow conversion of APRs to effective rates and vice versa:

- The [2nd F] [→EFF] keys allow calculation of an effective annual rate, given a nominal APR and the number of periods in a year.
- The [2nd F] [→APR] keys allow calculation of a nominal APR given an effective annual rate and the number of periods in a year.

Example:
Calculate the effective rate for 12 compounding periods with an 18% APR.
Enter:
12 [2nd F] [→EFF] 18 [=] Result: 19.56

Example:
Convert this rate back to an APR. (First store it by pressing [x→M].)
Enter:
12 [2nd F] [→APR] [RM] [=] Result: 18.00

Remember: Enter the number of compounding periods in the year first, press the conversion keys, then enter the rate.

Example:
What is the effective annual interest rate for 18% APR compounded daily?

Explanation:
The first question when dealing with daily compounding is, "how many days are in a year?" The answer may not be as simple as it seems. Some contracts are written with daily compounding based on a 360 day year and some are based on a 365 day year. (Neither of these are accurate, because a calendar year varies from 365 to 366 days a year.)
Assume that a year is considered to have 365 days.

Enter:
[2nd F] [TAB] [•]
365 [2nd F] [-EFF] 18 [=] Result: 19.71642428

All ten digits of this result are shown using [2nd F] [TAB] [•] because every digit is important with interest rates.

Different payment and interest periods
How does the EL-735 deal with daily compounding and monthly withdrawals, or monthly compounding and quarterly payments? One of the fundamental values in any financial calculation on the EL-735 is the period. There can only be one period, so the interest compounding period has to match the payment period. But in the real world they often don't match.

Where the payment and interest periods don't match, remember that two different interest rates compounded on two different periodic schedules are not considered different if they yield the same effective rate for the same period of time.

When the periodic interest rate is compounded on a period other than the payment period, it must be changed to a different periodic interest rate that compounds on the payment period but yields the same effective rate.

Example:
For a $200'000 loan with quarterly payments, the interest rate is 9.75% APR compounded monthly and the term of the loan is 5 years. What are the payments? Set the display to [2nd F] [TAB] [2].

Explanation:
Start this problem as if it were just a standard payment calculation on a 5 year loan with quarterly payments.

Enter:
5 [×] 4 [=] [n]
200000 [PV] 0 [FV]

Before entering the interest rate, convert it to a quarterly rate that yields the same effective annual rate as 9.75% compounded monthly.

Enter:
12 [2nd F] [→EFF] 9.75 [=] Result: 10.20

Store that effective rate in the M register, then calculate which APR compounded quarterly will yield the same effective rate.

Enter:
[x→M]
4 [2nd F] [→APR] [RM] [=] Result: 9.83

That is the correct APR based on quarterly compounding. Divide it by four and store it as the periodic interest rate.

Enter:
[÷] 4 [=] [i]

Now compute the payment on the loan.

Enter:
COMP PMT Result: −12'777.81

Quoting an effective interest rate
Lending laws require banks and financial institutions to quote effective annual rates (including prepaid finance charges), and total interest paid, on a loan or contract.

Example:
A lending institution loans $145'000 to an individual for a term of 18 years. The nominal interest rate is 14% APR compounded monthly, with a prepaid finance charge of 1.5%. Payments on the loan are monthly. What is the effective APR on this contact?

Explanation:
The first step in this solution is to calculate the payment based on the periodic rate (14 ÷ 12).

Enter:
145000 +/− PV
18 2nd F ×12
14 2nd F ÷12
0 FV
COMP PMT Result: 1'842.06

Now consider how the up-front finance charge reduces the net amount of money loaned without affecting the payment, and thus increases the actual interest rate.

Enter:
RCL PV − 1.5 2nd F % PV
COMP i (pause)
× 12 = Result: 14.27

This is the actual annual percentage rate on this loan. However, this rate is still a straight APR computed by multiplying the periodic rate by the number of periods in

a year. To compute the effective rate, use the [-EFF] key. First store 14.27 in memory, then compute the effective annual rate that results by compounding 14.27% twelve times.

Enter:

[X→M]

12 [2nd F] [-EFF] [RM] [=] Result: 15.24

So the actual, effective APR quoted by the lending institution is 15.24%. That rate includes prepaid finance charges and compounding.

Amortization

Amortization on a loan or mortgage separates, on a payment by payment basis, the amount of interest paid from the amount of principal paid. The EL-735 has three functions to calculate amortization. These functions are:

[AMRT] Breaks a single payment into principal and interest

[P₁/P₂] Enters a payment period for use by [ACC]

[ACC] Shows the accumulated interest and principal

Using these three functions, it is possible to amortize and quote principal and interest, either payment by payment, or over a series of payments.

The EL-735 uses information stored in the five TVM registers, n, i, PV, FV, and PMT, when building an amortization schedule, so the information in the TVM registers will already be correct.

Example:
What is the payment on a 15 year mortgage of $69'000 at 9.65% APR compounded monthly? Also, what is breakdown of interest-vs-principal at the end of each of the first three years?

Enter:
69000 [PV]
15 [2nd F] [×12]
9.65 [2nd F] [÷12]
0 [FV]
[COMP] [PMT] Result: −726.77

Now, since all the information about the loan is stored in the TVM registers, calculate the amortization. Compute the principal, interest, and balance from the first payment to the twelfth payment.

Enter:
1 [P₁/P₂] 12 [P₁/P₂] [ACC] ΣPRINCIPAL= −2'156.51

The display shows −2'156.51 and the "ΣPRINCIPAL=" indicator comes on, this stands for ACCUMULATED PRINCIPAL. This display indicates that the first twelve months of payments consist of $2'156.51 principal.

Enter:
[ACC] ΣINTEREST= −6'564.77

The display shows −6'564.77 and the "ΣINTEREST=" indicator comes on. This display indicates that the first twelve months of payments consist of $6'564.77 in interest.

Continue for the next 12 months.

Enter:

13 [P1/P2] 24 [P1/P2] [ACC] ΣPRINCIPAL= −2'374.07

[ACC] ΣINTEREST= −6'347.22

Continue for the third 12 months.

Enter:

25 [P1/P2] 36 [P1/P2] [ACC] ΣPRINCIPAL= −2'613.57

[ACC] ΣINTEREST = −6'107.71

It is possible to continue breaking the loan down year-by-year in the above fashion until the end of the 15th year is reached.

The above example creates an amortization schedule. Calculate the total interest paid on the loan in the above example.

Enter:

1 [P1/P2] 180 [P1/P2] [ACC] ΣPRINCIPAL= −69'000.00

This calculation will take a long time (around 10 seconds), but when it is finished, the display will show −69'000.00 with the "ΣPRINCIPAL= " indicator on in the display to tell you that the entire principal of the loan has been paid off. Press [ACC] again to see the total interest paid during this loan.

Enter:

[ACC] ΣINTEREST= −61'819.22

The "ΣINTEREST= " indicator comes on and the display shows 61'819.22. From the first payment to the last payment of this loan, a total of $61'819.22 in interest is paid.

Example:
In the above loan what is the interest and principal paid in the 45th payment and what balance is left to be paid on the loan after that payment?
Enter:

45 AMRT	PRINCIPAL= −244.53
AMRT	INTEREST = −482.25
AMRT	BALANCE=59'724.05

Discounted cash flow analysis

The NPV and IRR functions on the EL-735 depend on the fact that cash flows can be moved within a cash flow schedule. DCF analysis must be able to describe any cash flow schedule using just two functions:

2nd F Ni Number of cash flows in cash flow group i

CFi The value of the cash flow in group i

Ignore the TVM values of n, PV, FV, and PMT, and think in terms of cash flow groups. Every cash flow schedule is made up of connected groups of cash flows. These groups are characterized by the value of each cash flow making up the group and the number of cash flows in the group. A cash flow group could consist of ten $100 cash flows; fifty $10'000 cash flows; or up to ninety-nine cash flows of the same amount all in a row. These cash flow groups are numbered from left to right (starting from zero) on the cash flow schedule.

Cash flow data entry

Enter:
Value of Ni 2nd F Ni cash flow data CFi.

Number of input data values
Up to 70 (CF(0) to CF(69)).
(CFi data shares the same memory area as the financial

database. Up to 70 data items can thus be input only if no memory space has been used for the database.)

Step recall of stored cash flow data

Press [RCL] [CFi], then use the [∨] (or [∧]) key to recall the stored cash flow data values in ascending (or descending) order of 'i.' The [∨] and [∧] keys have a repeat capability when held down.

Direct search for CFi data

Any CFi data can be directly located by specifying the cash flow data number 'i' (e.g. 3 for CF(3)), then pressing [RCL] [CFi].

Correcting stored cash flow data

First locate the cash flow data to be corrected with the [∨] or [∧] key, position the cursor to the desired number with the [►], [◄] or [2nd F] [▲▼] keys, then type over with the correct number. Finally press the [ENT] key to complete the correction.

Inserting cash flow data

First use the [∨] or [∧] key to locate the cash flow data immediately before where data is to be inserted, then press [2nd F] [ENT]. "INSERT? ➡ ENT" will be displayed. Pressing the [ENT] key again puts the calculator into the insert mode. Now input the data you want to insert, then press [ENT] to complete your insertion.

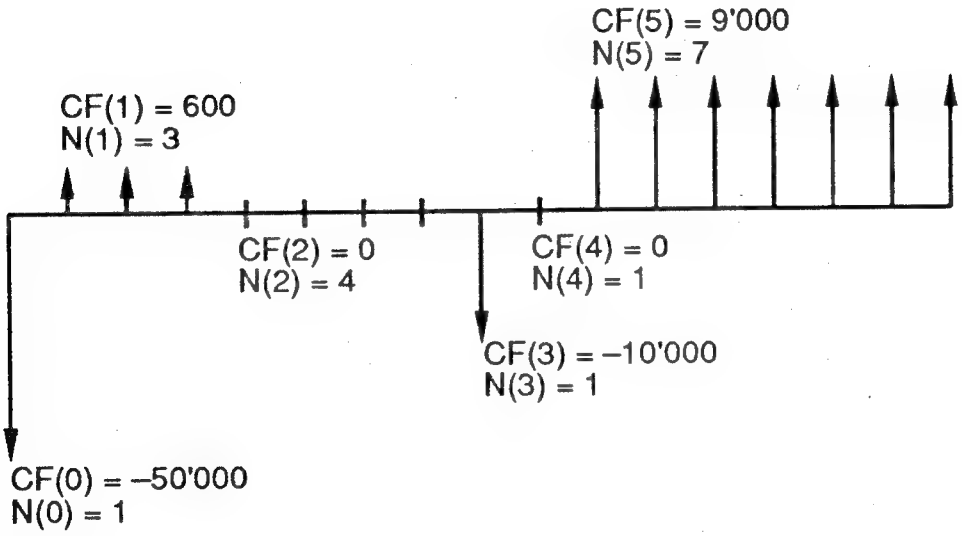
Deleting stored cash flow data

First use the [∨] or [∧] key to locate the cash flow data to be deleted, then press [2nd F] [CA]. "CL? ➡ ENT" will be displayed. Press [ENT] and the indicated data will be deleted.

Clearing all cash flow data

Press [RCL] [CFi], and the calculator will display "CFi SEARCH." Press [2nd F] [CA]. "CA CFi? ➡ ENT" will be displayed. Pressing [ENT] at this point clears all cash flow data from memory.

Here is an example of a cash flow schedule with 6 cash flow groups (numbered 0 to 5).



- Group zero has one cash flow of –50'000.
- Group one has three cash flows of 600 each.
- Group two has four cash flows of 0 each.
- Group three has one cash flow of – 10'000.
- Group four has one cash flow of 0.
- Group five has seven cash flows of 9'000 each.

Group zero is always the initial group on a cash flow schedule. Most often, group zero will consist of just one cash flow, but it can consist of up to 99. It is called "cash flow group zero" because the first cash flow in that group starts at the beginning of the first period, not the end.

Example:
Describe the above cash flow schedule, with six groups of cash flows, to the EL-735. Press [RCL] [CFi] [2nd F] [CA] [ENT] to clear all of the cash flow data.

Enter:
1 [2nd F] [Ni]
50000 [+/−] [CFi]

Enter cash flow group one.

Enter:
3 [2nd F] [Ni]
600 [CFi]

Continue the process for cash flow groups two to five.

Enter:
4 [2nd F] [Ni]
0 [CFi]

1 [2nd F] [Ni]
10000 [+/−] [CFi]

0 [CFi]

7 [2nd F] [Ni]
9000 [CFi]

Notice that for cash flow group four, consisted of one cash flow of 0, the entry [1] [2nd F] [Ni] was left off. It is always possible to leave off the entry [1] [2nd F] [Ni]. This entry was included in the previous groups, consisting of just one cash flow, only for clarity. Whenever [CFi] is pressed without first pressing [2nd F] [Ni], the EL-735 assumes that there is just one cash flow in the group.

After completing the above cash flow entry example, a cash flow schedule with very irregular cash flows has been described to the EL-735. Notice that this cash flow schedule has accounted for the beginning of the first period and the end of every period, it has not left off periods that have cash flows of zero.
So, with the information that has been entered, the EL-735 can deduce exactly what happens at each period on the cash flow schedule, from the beginning of the first period to the end of the last period.
The EL-735 can now answer either of two very important questions about the schedule that follow:

1. Given a periodic interest rate (stored in the i register), what is the value of all the cash flows on that schedule if they slide to the beginning of the first period (discounted according to the given interest rate) and are netted together? In other words, given a periodic interest rate, what is the Net Present Value (NPV) of the cash flows on the schedule?

2. What is the periodic interest rate that would make the Net Present Value equal to zero? This interest rate is called the Internal Rate of Return (IRR).

The answers to these two questions provide a wealth of information about financial problems with irregular cash flows.

IRR calculations require complex formulas and may not yield a unique mathematical result. The EL-735 follows any of the following three operational conventions depending on the cash flow data:

(1) If all cash flow data have the same sign, there is no solution to the problem, and the calculation results in an error.

(2) If cash flow data includes only one change of sign, there is only one solution to the problem and the EL-735 yields the solution.

(3) If cash flow data includes more than one change of sign, the EL-735 yields a solution which is in proximity to the expected value stored in the i memory.

Getting Solutions for Case (3) above

(i) In the case of (3) above, the EL-735 displays a message 'INPUT EST. i' to prompt entry of the estimated value.

(ii) Enter the estimated value into the i memory, then press [COMP] [IRR].

(iii) If the solution exists within ±10% of the estimated value, the EL-735 determines the solution. If there is no solution in this range, the EL-735 displays the prompt message 'INPUT EST. i' again.

The EL-735 will yield no solution if the solution is not in close proximity to the estimated value. Before entering the estimated value, compute NVP and verify that it is nearly equal to zero.

Net present value

To illustrate the use of the NPV function, consider the following example.

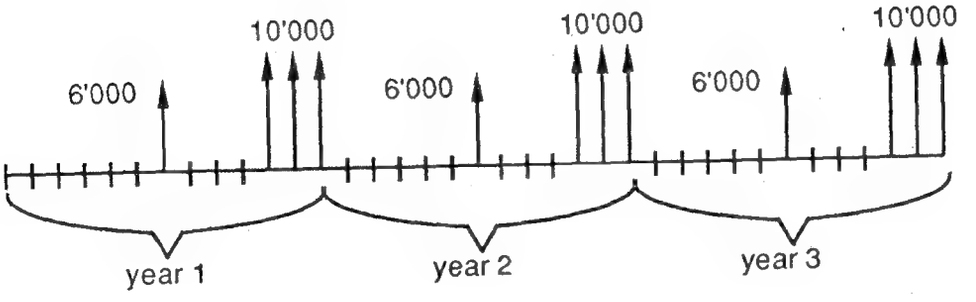
Example:
A lender wishes to sell a contract. The payment schedule calls for a $6'000 payment at the end of June and a $10'000 payment at the end of each of the three months October, November, and December for the next three years. An investor has some cash in a mutual fund that

has been getting about a 12% return, and would like to boost that return to around 18%. What should the investor pay for the contract?

Explanation:
This is a typical situation which would make good use of the NPV function. The periodic interest rate is known (or can be specified), and the investor must calculate what the schedule is worth up front.

This is what a sketch of the cash flow schedule would look like:

i = 18% APR (+12)



The difficult part of any NPV or IRR calculation is describing the cash flow schedule to the EL-735. An important thing to notice before entering the above cash flow schedule is that the group at the beginning of the first year (cash flow group zero) consists of six cash flows of zero each, while the groups at the beginning of the second and third years have only five cash flows of zero each.

Enter:

RCL CFi 2nd F CA ENT	Clear all registers
6 2nd F Ni 0 CFi	Group 0
6000 CFi	Group 1
3 2nd F Ni 0 CFi	Group 2
3 2nd F Ni 10000 CFi	Group 3
5 2nd F Ni 0 CFi	Group 4
6000 CFi	Group 5
3 2nd F Ni 0 CFi	Group 6
3 2nd F Ni 10000 CFi	Group 7
5 2nd F Ni 0 CFi	Group 8
6000 CFi	Group 9
3 2nd F Ni 0 CFi	Group 10
3 2nd F Ni 10000 CFi	Group 11

Once the cash flow schedule is stored in the EL-735, calculate the NPV given an interest rate of 18%.

Enter:

18 2nd F ÷12 NPV	Result: 78'505.16

So, to make an 18% APR return on the investment by buying the contract, the investor should pay $78'505.16. Notice that the result of sliding all those positive cash flows to the beginning of the time and discounting them according to the 1.5% periodic rate, is a positive value. Unlike the TVM functions PV and FV, the NPV function makes no assumptions when it is used to slide cash flows. NPV does not change the signs of cash flows as it slides them to the front of the cash flow schedule. NPV treats each cash flow as a separate loan.

Whenever the IRR key on the EL-735 is used, the result is stored in the i register. This result can then be used in a TVM problem, or recalled by pressing RCL i. Once the cash flow schedule is entered, the calculation of the IRR is a one key operation. The IRR calculation may take a little time.

Note:

When entering numbers, do all calculations first. Do not do calculations while entering the [CFj] and [Nj] list.

Discounted cash flow examples

Financial calculations that require discounted cash flow analysis cover a large range of investment situations. Often, the problems are fairly complex and require some preparation. Many times, in order to reach the final cash flow schedule for a DCF analysis problem, several TVM calculations may be required.

Example:
Based on the following table of investments, what has the return on mutual funds been since 1983?

Date	Fund No.	Amount Invested
11/15/83	1	5'000
6/1/84	1	3'200
8/15/85	2	2'000
4/30/86	3	2'000
1/15/87	2	2'750
6/1/87	3	1'500
9/1/87	2	4'000

Today is 5/1/88 and the values of the funds at this date are as follows:

- Fund 1: $15'355.70
- Fund 2: $12'921.24
- Fund 3: $4'723.75

Explanation:
Even though there are three funds listed with three separate yields, in this case the solution concerns the overall combined yield. This becomes a single problem

with all of the investments and current values appearing on one cash flow schedule.

One trick to analyzing this investment is the selection of the period for the cash flow schedule. Here, the investments took place either around the 1st of the month or the 15th of the month. So, break each year up into 24 periods, each about 1/2 month. That way, each investment will fall at the end of a period.

Once the periodic return for 1/2 month periods is calculated, convert it to reflect monthly compounding if required.

The cash flow schedule will look something like this:

Enter:

RCL CF*i* 2nd F CA ENT	
5000 +/− CF*i*	Group 0
12 2nd F N*i* 0 CF*i*	Group 1 (12 zeros)
3200 +/− CF*i*	Group 2
28 2nd F N*i* 0 CF*i*	Group 3 (28 zeros)
2000 +/− CF*i*	Group 4
16 2nd F N*i* 0 CF*i*	Group 5 (16 zeros)
2000 +/− CF*i*	Group 6
16 2nd F N*i* 0 CF*i*	Group 7 (16 zeros)
2750 +/− CF*i*	Group 8
8 2nd F N*i* 0 CF*i*	Group 9 (8 zeros)
1500 +/− CF*i*	Group 10
5 2nd F N*i* 0 CF*i*	Group 11 (5 zeros)
4000 +/− CF*i*	Group 12
15 2nd F N*i* 0 CF*i*	Group 13 (15 zeros)
33000.69 CF*i*	Group 14

Finally, calculate the internal rate of return.

Enter:

IRR	Result: 0.73

IRR calculations can take some time on the EL-735, depending on how many cash flow groups are entered. The EL-735 is approaching the answer through a numerical approximation process. Many approximations are required before it arrives at a solution.

The final result is a periodic rate based on 24 half-month periods. To annualize this rate, multiply by 24.

Enter:
[×] 24 [=] Result: 17.55

Convert this 17.55% rate from an annual rate compounded semi-monthly to an annual rate compounded monthly.

Enter:
[x→M]
24 [2nd F] [→EFF] [RM] [=]
[x→M]
12 [2nd F] [→APR] [RM] [=] Result: 17.61

Partial periods

Calculating [n] has not yet been mentioned in this manual. The reason for not mentioning [n] is that, though on the surface it seems fairly straightforward, when solving for [n], chances are the answer will not be an integer. If [n] is solved and the answer does not come out to be an integer, how should that partial period be interpreted?

On the EL-735, when the value for n is not an integer, the EL-735 can still calculate an answer for PV, PMT, i, or FV, but it makes two assumptions:

1. It assumes that the partial period occurs at the beginning of the time.
2. It assumes that "continuous compounding" is used during the partial period.

These two assumptions on the handling of partial periods make the EL-735 a useful tool particularly in the field of bond transactions, which are the subject of the next section.

Bond calculations

The EL-735 is equipped with new powerful features which allow it to perform bond calculations.

Bond calculations are slightly different from the financial calculations discussed up to now. If a bond is purchased, then at some date in the future that bond will mature and will have a "redemption value." It is this "redemption value" that is usually the starting point for calculations of the bond. This is different from a loan or mortgage where the present value (the amount at the beginning of the time) is usually the starting point for the calculations. The redemption value of a bond is generally a known quantity.

Bonds also have associated with them what is called a "coupon." The "coupon" is a percentage of the redemption value received annually by the owner of the bond. The "coupon" is like an "interest only payment," and it is based on the future value of the bond.

On bonds that have "annual coupons," the owner receives one payment of the coupon amount each year. Some bonds have "biannual coupons" which means that each year's coupon amount is paid in two equal payments six months apart. The date on which a coupon payment is made is called the "coupon date." The bond maturity date is usually the last coupon date.

The common unknown values in bond calculations are "price" and "yield-to-maturity." If the purchase date of a

bond falls on a coupon date, these calculations are easy. The previous owner keeps the coupon payment that has accumulated over the past period, and the new owner pays a certain "price" for the bond that depends on the desired "yield" for owning the bond.

However, the purchase date rarely falls on a coupon date, and it is almost always necessary to deal with a partial period. Thus, when purchasing a bond, it is necessary to pay a certain "price" for the bond, plus pay the previous owner the amount of the upcoming coupon payment that has accumulated so far in the current period.

Bond calculation rules

The EL-735 calculates bond price and YTM under the following rules:

1. Whenever the redemption date happens to be the last day of a month, coupons are also paid on the last day of the month.
   For example, if coupons are to be paid twice a year and the redemption date is set to September 30, coupon payments occur on March 31 and September 30.
2. If coupons are to be paid twice a year and the redemption date is set to August 29, 30 or 31, coupon payment for February occurs on the 28th (29th for leap year).
3. The 'Odd Coupon' is not supported.
4. The bond calculation clears the contents of the CST, SEL, MAR, MU and DAYS registers.

The solution of what were once complex calculations becomes simple when using the BOND PRICE and YTM keys combined with the day/date feature of the EL-735.

Calculating bond price

1. Use the [2nd F] [360/ACT] keys to select 360 or ACTUAL calendar.
2. Enter the number of coupon payments with the [n] key.
3. Enter the target yield with the [i] key.
4. Enter the coupon payment rate with the [PMT] key.
5. Enter the redemption payment with the [FV] key.
6. Enter the date of bond purchase with the [DATE1] key.
7. Enter the redemption date with the [DATE2] key.
8. Calculate bond price by pressing [2nd F] [PRICE]. (Press [x→M] to store the bond price in memory.)
9. Press [ACC] to calculate accrued interest.

Add the accrued interest to bond price (RM) to calculate the final bond price including accrued interest. Steps 1 to 7 can be executed in any sequence.

Calculating yield to maturity

In step 3 above, enter bond price into [PV] instead of entering target yield. Other steps are the same down to 7. Finally, for step 8 press [2nd F] [YTM] to calculate the yield to maturity.

Example:

An invester is offered an opportunity to purchase some bonds. The bonds have two coupon payments of 6.75% per year, a redemption value of $100.00 and a redemption date of JUNE 4, 2002. Today's date is APRIL 28, 1988 and the bonds use an actual calendar. The bonds are offered at a price of $88.30. For a target yield to maturity of 8.25% calculate the actual bond price and the yield to maturity on a bond price of $88.30. The EL-735 should be in the ACT calendar mode and the END submode.

Enter:

[2nd F] [CA]

2 [n]

8.25 [i]

6.75 [PMT]

100 [FV]

4.281988 [DATE1] (Thursday)

6.042002 [DATE2] (Tuesday)

[2nd F] [PRICE] Display: 87.62

[x→M]

[ACC]

[+] [RM] [=] Display: 90.31

So the bond price including accrued interest would be $90.31.

Now calculate the yield to maturity for the offered bond price of $88.30.

Enter:

88.30 [PV]

[2nd F] [YTM] Display: 8.16

So the bond yield to maturity at a price of $88.30 will be 8.16%

Financial database

The Financial database feature allows storage of stock prices, exchange rates, and any other financial information. It then lets the user recall any data items required and use them directly in financial calculations.

Data entry

To enter data in the Financial database the EL-735 must be in the Financial mode.

Press [2nd F] [DATA] to select database entry, the prompt "NAME?" will be displayed, the ALPHA entry mode is automatically selected and the "ALPHA" indicator is displayed. The ALPHA mode allows the entry of the alphabet and the symbols / , ␣(space) and , (comma). To enter numbers 0 to 9, • , % and −, it is necessary to clear the ALPHA mode by pressing the [ALPHA] key (the "ALPHA" indicator will disappear.) Pressing the [ALPHA] key toggles between the ALPHA entry mode and the number entry mode.

Enter the data name and then press [2nd F] [▲▼], the lower display line flashes to prompt the entry of the data value.

Enter the data value using only the [0] to [9], [•], [RM] and mathematic function keys. Then press [ENT] to complete data entry. If [ENT] is not pressed, the data will not be stored in the EL-735 Financial database.

Acceptable characters for data names

1. Uppercase alphabetic characters: A, B, C, ..., Z
2. Lowercase alphabetic characters: a, b, c, ..., z (e.g. [2nd F] [A] enters a.)
3. Special symbols: Space (␣) , comma (,), slash (/), percent (%), dot (.), hyphen/minus (−)
4. Numbers: 0, 1, 2, ..., 9

Example:
Store the dollar — yen exchange rate in the financial database.

Enter:

[2nd F] [DATA] Display: NAME?

[D] [O] [L] [L] [A] [R] [ALPHA] [—] [ALPHA] [Y] [E] [N] [2nd F] [▲▼]

125.4

[ENT]

Entering results of calculations into the database

After obtaining a calculation result, press [2nd F] [DATA], the prompt "NAME?" will appear and the results of the calculation are still displayed. Enter the data name and then press [ENT] to complete the entry.

Example:
Calculate the square root of 40 and store it in the database.

Enter:

40 [2nd F] [√‾]

[2nd F] [DATA]

[R] [O] [O] [T] [␣] [ALPHA] 40

[ENT]

Recalling and correcting stored data

Press [2nd F] [DATA], the "NAME?" prompt will be displayed. Press the [∨] or [∧] key to recall database entries, holding the key down for fast recalls of the database entries. Use the [◄], [►], or [2nd F] [▲▼] keys to position the cursor over the character to be corrected and type over with the correct entry. Press [ENT] to complete the entry or the correction will not be stored in the database and the old data will remain.

The contents of database are sorted in the following order:

1. Spaces
2. Uppercase alphabetic characters (in alphabetic order)
3. Lowercase alphabetic characters (in alphabetic order)
4. Numbers (ascending order)
5. Hyphen (−)
6. Dot (·)
7. Comma (,)
8. Percent (%)
9. Slash (/)

Deleting a specific data item

Recall the data to be deleted with the [∨] or [∧] key, then press [2nd F] [CA]. "CL? ➡ENT" will be displayed. Press [ENT] to clear that item. Press any other key to save that item.

Deleting all stored data

Press the RESET switch, "CL ALL? ➡ENT" will be displayed. Press the [ENT] key to delete all stored data, including the contents of the financial, statistical and independently accessible memories. Press any other key to save the contents.

Memory capacity

Since the database and CFi data share the same memory area, the memory space available to database or CFi depends on how much space is occupied by the other. In the initial default state (after reset), a total memory space of 560 bytes (corresponds to 70 CFi data) is available.
To check the remaining memory space.

Enter:

[2nd F] [M.CK] (hold)	Display:	CHR or CFi
		560 70

The message above indicates that space for the full 560 characters (bytes) is available to the database, or that space for 70 data is available to CFi.

Memory capacity required for one data item is:

1. Data base: (data name character count + 10) bytes
2. CFi data: 8 bytes per data

These examples of the simple and powerful bond calculation feature and the Financial database complete the description of the EL-735 financial functions. By using the examples in this chapter as a guide, the user should be able to solve the most complex financial and business problems.

Statistics

The EL-735 can be used as a powerful statistics calculator. To activate the statistics functions on the keyboard, press the [2nd F] [STAT] keys. The "STAT" indicator will be displayed.

Only the statistics functions in the bottom four rows of the keyboard, the basic math functions and the [%] and [Δ%] functions are active. The memory keys [x→M], [RM], and [M+] change their primary meanings to become the [CD], [(x,y)], and [S.DATA] keys. These keys are used to enter the numbers (data) used in statistical calculations. The meanings of these three keys are as follows:

[S.DATA] Enter data

[(x,y)] Two variable statistics data entry

[CD] Correct data

The EL-735 offers functions for both single-variable and two-variable statistical calculations. The explanation in this chapter assumes some knowledge of the statistical functions. Single-variable statistics are used to total a list of numbers and calculate the mean ($\bar{x}$), standard deviation (sx or σx), and sum of the squares (Σx^2) of the list of numbers. Two-variable statistics can perform all the functions of single-variable statistics on a list of number pairs, plus they can be used for linear regression (mathematically approximating a straight line through a set of "x,y" data pairs), for linear forecasting (on a straight line), and for exponential regression and forecasting.

Linear regression assumes knowledge of the formula for a straight line on a two dimensional (x,y) coordinate system ($y = ax + b$, where a is the "slope" of the line

and b is the "y intercept"), correlation and the correlation coefficient. The [2nd F] [r] keys calculate the correlation coefficient for a set of data pairs in linear regression calculations. The correlation coefficient is a measure of how close the data points in a set are to the straight line that approximates their path.

In any statistical calculation, once the numbers are entered correctly, the statistical functions of the EL-735 take care of all the complex calculations.

To clear the Statistics registers, press [2nd F] [CA]. The EL-735 will return to the Financial mode and all registers (Financial and Statistics) will be cleared. To continue Statistics calculations it will be necessary to select the Statistics mode again using the [2nd F] [STAT] keys.

Single-variable statistics

In single-variable statistics, data are referred to with "x" function names. The functions that can be used are:

[2nd F] [$\bar{x}$] x samples mean
[2nd F] [sx] x sample standard deviation
[2nd F] [σx] x population standard deviation
[2nd F] [Σx] Sum of the x samples
[2nd F] [Σx^2] Sum of the x samples squared

Example:
Twelve company drivers calculate the fuel consumption of their company vehicles for a month. The figures are as follows:

Vehicle No.	Fuel usage (ℓ)
1	713
2	497
3	626
4	734

5	569
6	403
7	403
8	657
9	585
10	742
11	611
12	467

If the EL-735 is not in the STAT mode, press the [2nd F] [STAT] key until the "STAT" indicator is displayed. Set [2nd F] [TAB] [2]. Enter all the numbers then, press [2nd F] [$\bar{x}$] to calculate the mean.

Enter:

[2nd F] [CA]
[2nd F] [STAT]
713 [S.DATA]
497 [S.DATA]
626 [S.DATA]
734 [S.DATA]
569 [S.DATA]
403 [×] 2 [S.DATA] (Enter 2 data)
657 [S.DATA]
585 [S.DATA]
742 [S.DATA]
611 [S.DATA]
467 [S.DATA]
[2nd F] [$\bar{x}$] Result: 583.92

The fleet of vehicles averaged 583.92 litres per vehicle during the month.
Pressing the [S.DATA] key in the STAT mode after entering a single data enters that data in the statistical memory. When this key is pressed, the calculator displays how many data have been entered. Pressing [2nd F] [n] recalls n to the display.

Occasionally a list of data has weights associated with certain entries (many repetitions of the same entry). To speed up the entry of multiple data, use the [×] key during the entry of data, as shown in the example above. The [×] key can be used during data entry with either single variable or two variable statistics.

To calculate standard deviation for the above list of fuel consumptions, determine which type of standard deviation applies. The [2nd F] [sx] keys calculates sample standard deviation and the [2nd F] [σx] keys calculate population standard deviation.

Sample standard deviation assumes that data is a sample of a larger population.

Population standard deviation assumes that the data entered is the entire population.

In the case of the vehicle fuel consumptions, population standard deviation should be calculated, because the 12 vehicles are the entire population. If the calculations were, for example, a survey to estimate the consumption of a certain model vehicle based on a sample of 12 road tests, sample standard deviation should be chosen so that the results can be applied to all vehicles of that model.

For the list of numbers entered, press [2nd F] [σx] to calculate the population standard deviation and press [2nd F] [sx] to calculate the sample standard deviation. Variance is the standard deviation squared. Press [2nd F] [x²] after calculating the standard deviation to calculate variance.

Correcting statistics data

The EL-735 has a function that allows correction of errors made when entering statistical data. In the statis-

tics mode, the [x→M] key changes its primary meaning to [CD] which stands for "correct data."

Example:
Refer to the previous example and assume that the driver of vehicle number 4 found that he had made an error in his calculation. After checking he found that his consumption for the month was actually 720, not 734.

Correct the error and recalculate the mean consumption based on the new data.

Enter:
734 [CD]
720 [S.DATA]
[2nd F] [$\bar{x}$] Result: 582.75

Notice when making the above changes, that when 734 [CD] is entered the EL-735 displays "$n = 11$", indicating that it has removed one of the 12 data. When the correct data is entered by pressing 720 [S.DATA], the EL-735 displays "$n = 12$", which is the number of data in the complete list.

Two-variable statistics

When a second variable is added to statistical calculations, the number of potential applications increases considerably. The most time-consuming part of solving a two-variable statistics problem on the EL-735 is entry of the (x,y) data pairs.

The statistical functions on the EL-735 that require the input of two-variable data pairs are as follows:

[2nd F] [$\bar{y}$] y samples mean
[2nd F] [Sy] y sample standard deviation
[2nd F] [σy] y population standard deviation

[2nd F] [Σxy] Sum of the pair products (x times y)
[2nd F] [Σy] Sum of the y samples
[2nd F] [Σy^2] Sum of the y samples squared

Linear regression functions
[2nd F] [r] Correlation coefficient
[2nd F] [a] y intercept, for the linear regression formula $y = a + bx$
[2nd F] [b] Slope in the linear regression formula
[2nd F] [x'] Return a predicted x for a given y
[2nd F] [y'] Return a predicted y for a given x

Entering Data

The two numbers in the statistical data pairs used in two-variable statistics are called "x" and "y." To enter a data pair, enter the x value, press the [(x,y)] key, enter the y value, and press [Σ DATA]. To correct a data entry, enter the incorrect x, press the [(x,y)] key, enter the incorrect y, press [CD] and then enter the correct date.

Example:
For a stock investment in January of 1983, the value of the stock has increased in value steadily according to the following table.

Year	Stock Value
1983	45000
1984	46976
1985	49254
1986	51770
1987	52624
1988	54190

What has been the average value of this investment during those years?

Enter six data pairs for this problem: (1983, 45000), (1984, 46976), (1985, 49254), (1986, 51770), (1987, 52624), and (1988, 54190).

Enter:

[2nd F] [CA] [2nd F] [STAT]
1983 [(x,y)] 45000 [Σ DATA]
1984 [(x,y)] 46976 [Σ DATA]
1985 [(x,y)] 49254 [Σ DATA]
1986 [(x,y)] 51770 [Σ DATA]
1987 [(x,y)] 52624 [Σ DATA]
1988 [(x,y)] 54190 [Σ DATA]

As the above six data pairs are entered, the calculator counts them (as $n=$) in the display. It is possible at any time to see how many data pairs have been entered by pressing [2nd F] [n]. At the end of entering the data, $n=6$ should be displayed.

Once the data has been entered, answer the question: "What is the average value of the stock over the years?"

Enter:

[2nd F] [$\bar{y}$] Result: 49'969.00

The [$\bar{y}$] key returns the mean of the y values. In this case, the stock value was entered as the y component of each data pair, so [$\bar{y}$] returns the average stock value over the years.

Linear regressions

This graph shows the six data points from the previous example plotted with a line drawn to approximate their trend over the years 1983 to 1988. The line is extended to the year 2000 to predict the stock value.

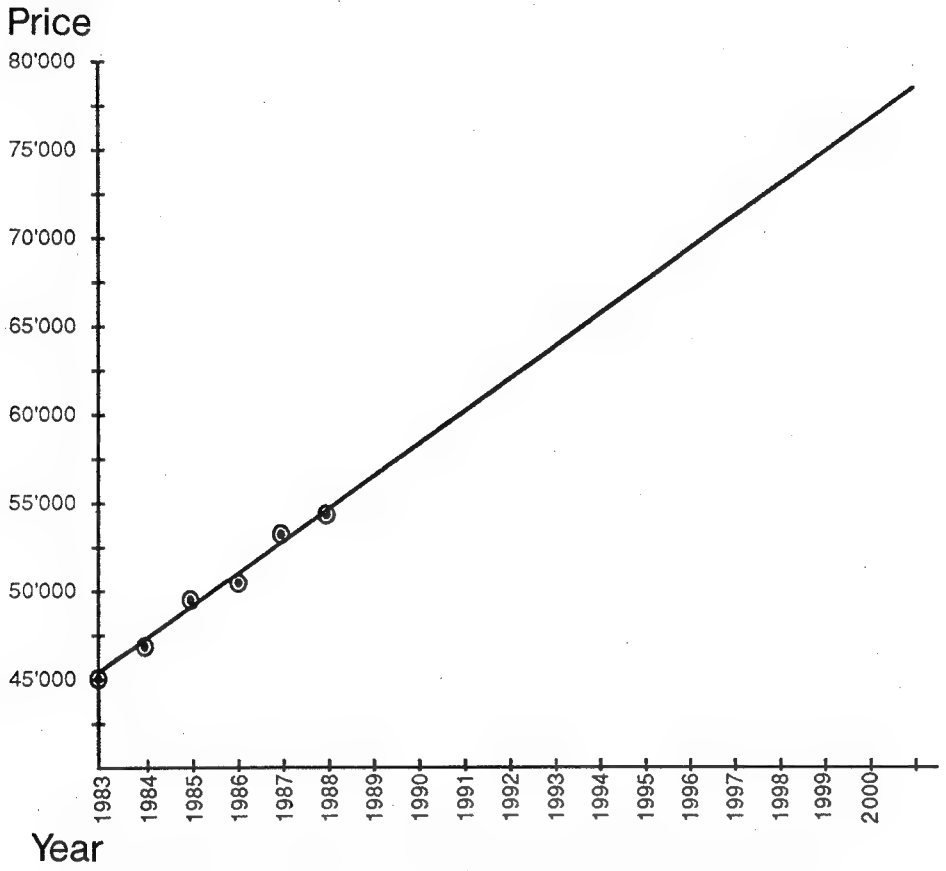


Fig. Linear regression of stock value data

Example:
For the previous example, if the increase in value can be approximated by a straight line (in other words, if the trend of the last five years stays constant) what will the stock value be in January of the year 2000?

Enter:
2000 [2nd F] [y'] Result: 77'067.43

Of course, this is just a simple example to demonstrate the *y'* function. It would not be wise to use a linear extrapolation on a five-year trend in stock value to evaluate the future value of an investment.

The slope, y-intercept and correlation coefficient

Three important values in linear regression are a, b, and r. The values a and b come from the equation for a line ($y = a + bx$), where a is the point where the line crosses the y-axis (the vertical axis) and b is the slope of the line. By using the equation for a line, it is possible to describe any straight line. The value r is called the correlation coefficient, and it is a measure of how closely the data points fit the line described by a and b.

The correlation coefficient r ranges from -1 to 1. The closer this value is to 1 or -1, the closer the data points are to linear correlation. For a certain set of data, if r is close to zero, the linear correlation is poor, which means that a straight line is a poor choice for modeling that set of data.

Example:
Calculate r for the previous example.

Enter:

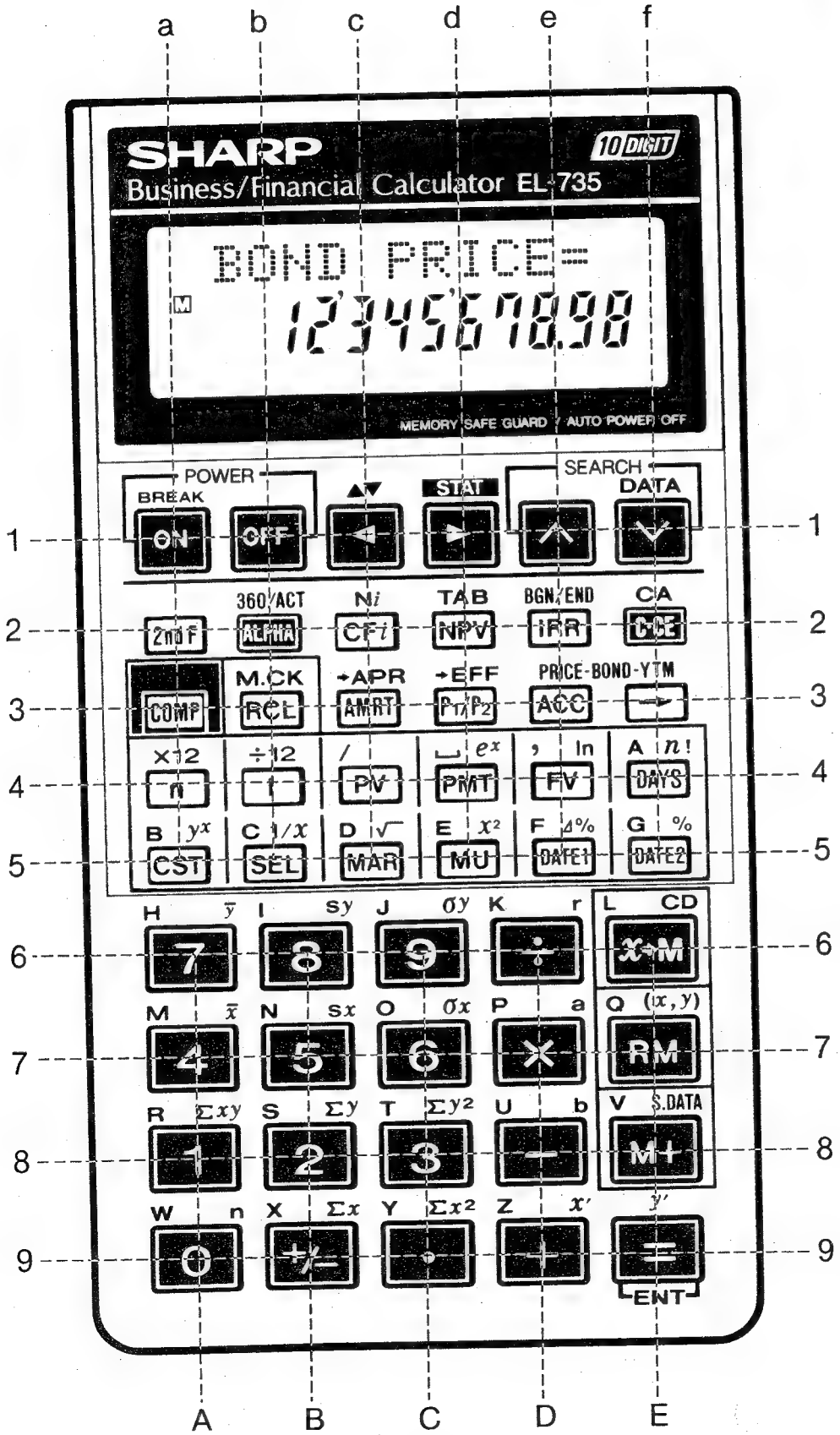
2nd F TAB •	Show all decimal places
2nd F r	Result: 0.990733242

As this value for r is almost 1, this indicates the line was a good fit to the data points.

These examples demonstrate what an effective tool the EL-735 is for all statistical calculations, and complete the introduction to the functions of this powerful Business/Financial Calculator. SHARP hopes that the EL-735 user will extend their range of knowledge and have many years of successful use from the EL-735.

APPENDICES

A. KEYBOARD



B. KEY OPERATIONS

Key	Location	Operation	Function
ON/BREAK	1a	BREAK ON	Turns the power on. Provides the BREAK function when pressed during long calculations, suspends calculation and shows intermediate results.
OFF	1b	OFF	Turns the power off. The EL-735 also has an auto power off feature which turns the power off if there is no key entry for several minutes, the memory is safeguarded.
Cursor left Change line	1c	◄ 2nd F ▲▼	Cursor left key, hold to repeat. Changes lines in the display.
Cursor right STAT Mode	1d	► 2nd F STAT	Cursor right key, hold to repeat. Selects the Statistics mode, "STAT" appears in the display, press again to clear.
Search up	1e	^	Search up key, hold to repeat.
Search down Database select	1f	v 2nd F DATA	Search down key, hold to repeat. Selects the Financial database submode.
2nd function	2a	2nd F	Secondary function designation key.
ALPHA Calendar	2b	ALPHA 2nd F 365/ACT	Selects the ALPHA submode, allows alphabetic data input, "ALPHA" appears in the display. Toggles the calendar function between 365 (actual) and 360 (360 appears in the display) day calendars.
Cash flow Cash flow number	2c	CFj 2nd F Nj	Cash flow memory key. Specifies the number of cash flows in a cash flow group.
NPV TAB	2d	NPV 2nd F TAB	Net present value key. Specifies the numbers of decimal places in the display.
IRR Begin/End	2e	IRR 2nd F BGN/END	Internal rate of return key. Allows calculation of payments at the beginning or end of the period.
Clear/Clear entry Clear all	2f	C-CE 2nd F CA	Press once to clear only the current entry. Press twice to clear the display, (memory and stored data are not affected). Clears the Financial and Statistics registers, retains memory contents, returns to the Financial mode.

Key	Location	Operation	Function
Compute	3a	[COMP]	Computes results using built-in programs.
Recall Memory check	3b	[RCL] [2nd F] [M.CK]	Recalls the contents of registers and memory. Checks remaining database/cash flow memory space.
Amortization Annual percent	3c	[AMRT] [2nd F] [-APR]	Performs the amortization calculation. Converts effective interest rate to an annual percent (nominal) rate.
P1/P2 Effective interest	3d	[P1/P2] [2nd F] [-EFF]	Defines the period for accumulated principal and interest. Converts annual percent (nominal) interest rates to annual effective interest rates.
Accumulation Bond price	3e	[ACC] [2nd F] [PRICE]	Calculates accumulated principal and interest for the period, must always be preceded by P1/P2. Designates or calculates bond price.
Right shift Bond yield	3f	[→] [2nd F] [YTM]	Right shift key, moves the display right. Calculates bond yield to maturity.
Number of periods × 12	4a	[n] [2nd F] [×12]	Designates or calculates the number of periods. Calculates the number of monthly periods from years, the result is stored in the n registers.
Interest ÷12	4b	[i] [2nd F] [÷12]	Designates or calculates interest. Calculates monthly interest rate from annual interest rate, the result is stored in the i register.
Present value	4c	[PV]	Designates or calculates the present value.
Payment Exponential	4d	[PMT] [2nd F] [e^x]	Designates or calculates periodic payments. Calculates the exponential function.
Future value Natural logarithm	4e	[FV] [2nd F] [ln]	Designates or calculates future values. Calculates the natural logarithm function.
DAYS Factorial	4f	[DAYS] [2nd F] [$n!$]	Designates or calculates the number of days in a calendar period. Calculates the factorial function.

Key	Location	Operation	Function
Cost Power	5a	CST 2nd F y^x	Designates or calculates cost. Used to raise a number to a power.
Sell Reciprocal	5b	SEL 2nd F $1/x$	Designates or calculates selling price. Calculates the reciprocal.
Margin Square root	5c	MAR 2nd F $\sqrt{\ }$	Designates or calculates gross margin. Calculates the square root of a number.
Markup Square	5d	MU 2nd F x^2	Designates or calculates markup. Calculates the square of a number.
DATE 1 Percent	5e	DATE1 2nd F $\Delta\%$	Designates or calculates the initial date. Calculates percent change (increase or decrease).
DATE 2 Percent	5f	DATE2 2nd F %	Designates or calculates the final date. Calculates percentages and add on/discount.
A — Z a — z	4f-9D 4f-9D	A — Z 2nd F A — 2nd F Z	Enters uppercase letters in the database. Enters lowercase letters in the database.
Slash Space Comma	4c, 4d, 4e	/ ␣ ,	Enters the slashes, spaces, and commas in the database.
Statistical keys: $\bar{y} - y'$	6A — 9E	$\bar{y}$ — y'	Designates or calculates the statistical functions in the Statistical mode.
0 — 9	6A — 6C, 7A — 7C, 8A — 8C, 9A	0 — 9	Enter the numbers 0 to 9.
÷, ×, −, +	6D — 9D	÷, ×, −, +	Enter the calculation operators.
Decimal point	9C	.	Enters the decimal point, defines decimal place.
Change sign	9B	+/−	Changes the sign of the displayed number from positive to negative, or vice versa.
Memory	6E, 7E, 8E	$x \rightarrow M$, RM, M+	Performs memory operations.
Equals Entry	9E	= ENT	Performs calculations and displays the result. Enters data in Financial calculations.

C. DISPLAY

Symbols and Indicators

M	A number other than zero is stored in the memory
–	The number displayed is a negative number
E	An overflow or an error is detected
2ndF	The 2nd function is designated
BGN	Calculations are based on the beginning of the month
STAT	The statistical calculation mode is set
ALPHA	The alpha submode is selected, allows the entry of alphabet characters
360	Date calculations are based on a 360 day year, (12 months with 30 days)

D. ERRORS

In the case of an error, the symbol "E" will be displayed. An error will be caused by calculations or instructions beyond the capacity of the machine. An error can be cleared by the C·CE key.

Error Conditions

1. When the absolute value of a calculation result is greater than $9.999999999 \times 10^{99}$.
2. When a number is divided by 0 (zero), e.g., A ÷ 0.
3. When the absolute value of the result of a memory calculation is greater then $9.999999999 \times 10^{99}$.

For special functions an error occurs when the following calculation ranges are exceeded.

Errors in Days and Date Calculations

1. Attempt was made to input a date which is not on the calendar, e.g. February 30.
2. Entry or calculation was attempted which exceeds the range January 1, 1901 to December 31, 2099.

Errors in Bond Calculations (YTM, PRICE)

1. A negative value was input to n, i, PMT, or FV.
2. DATE1 is equal to or greater than DATE2 (settlement date $\geqq$ redemption date).

Errors in Compound Interest Calculations (n, i, PV, FV, PMT)

1. $i \leqq -100$.

2. $n = 0$ in PMT calculation.

3. $i = 0$ and $PMT = 0$,
   or $i \neq 0$ and $FV = (1/r)(1+r \cdot s)\,PMT$, in n calculation.
   END mode: $s = 0$
   BGN mode: $s = 1$

4. In i calculation:
   (1) If $PMT > 0$:
   END mode: $PV \geqq 0$ and $FV + PMT \geqq 0$.
   $PV < 0$ and $FV + PMT < 0$.
   BGN mode: $PV + PMT \geqq 0$ and $FV \geqq 0$.
   $PV + PMT < 0$ and $FV < 0$.

   (2) If $PMT < 0$:
   END mode: $PV > 0$ and $FV + PMT > 0$.
   $PV \leqq 0$ and $FV + PMT \leqq 0$.
   BGN mode: $PV + PMT > 0$ and $FV > 0$.
   $PV + PMT \leqq 0$ and $FV \leqq 0$.

   (3) If $PMT = 0$: $PV/FV \geqq 0$

Errors in IRR Calculations

1. All CFi data have the same sign.
2. $Ni = 0$, $Ni \geqq 100$ or $Ni \neq$ integer.

Errors in Amortization

1. AMRT
   $x \leqq 0$, $x \neq$ integer or $x \geqq 1 \times 10^{10}$

2. ACC
   $P1 \leqq 0$ or $P2 \leqq 0$.
   $P1 \neq$ integer or $P2 \neq$ integer.
   $P1 > P2$.

Errors in Statistic Calculations

Single-variable data and two-variable data have been entered concurrently.

Errors in Database or CFi Data Entry

Attempt was made to store into memory data which exceeds 560 bytes or 70 CFi. In this case, a "MEMORY FULL!" error occurs.

E. RANGES

The calculation range of various functions are as given in the following table. The range for keyboard entry and for the four arithmetic functions is 0 and $\pm 1 \times 10^{-99}$ to $\pm\ 9.999999999 \times 10^{99}$. A number whose absolute value is less than 1×10^{-99} becomes a zero. The range for the calendar is Jan. 1, 1901 to Dec. 31, 2099.

Functions		Dynamic range
$\ln x$		$1 \times 10^{-99} \leqq x \leqq 9.999999999 \times 10^{99}$
e^x		$-9.999999999 \times 10^{99} \leqq x \leqq 230.2585092$
y^x		• $y>0$: $-9.999999999 \times 10^{99} \leqq x \log y \leqq 99.99999999$ • $y=0$: $1 \times 10^{-99} \leqq x \leqq 9.999999999 \times 10^{99}$ • $y<0$: x: integer or $\frac{1}{x}$: odd number ($x \neq 0$). and $-9.999999999 \times 10^{99} \leqq x \log \lvert y \rvert \leqq 99.99999999$
$\sqrt{x}$		$0 \leqq x \leqq 9.999999999 \times 10^{99}$
x^2		$\lvert x \rvert \leqq 9.999999999 \times 10^{49}$
$1/x$		$\lvert x \rvert \leqq 9.999999999 \times 10^{99}$ $x \neq 0$
$n!$		$0 \leqq n \leqq 69$ (n: integer)
Statistical calculation	Data CD	$\lvert x \rvert \leqq 9.999999999 \times 10^{49}$ $\lvert y \rvert \leqq 9.999999999 \times 10^{49}$ $\lvert \Sigma x \rvert \leqq 9.999999999 \times 10^{99}$ $\Sigma x^2 \leqq 9.999999999 \times 10^{99}$ $\lvert \Sigma y \rvert \leqq 9.999999999 \times 10^{99}$ $\Sigma y^2 \leqq 9.999999999 \times 10^{99}$ $\lvert \Sigma xy \rvert \leqq 9.999999999 \times 10^{99}$ $0 \leqq n \leqq 9999999999$ (n: integer)
	$\bar{x}, \bar{y}$	$n \neq 0$
	sx	$n>1$ $0 \leqq \frac{\Sigma x^2 - n\bar{x}^2}{n-1} \leqq 9.999999999 \times 10^{99}$
	σx	$n>0$ $0 \leqq \frac{\Sigma x^2 - n\bar{x}^2}{n} \leqq 9.999999999 \times 10^{99}$

Statistical calculation	s_y	$n>1$ $0 \leqq \frac{\Sigma y^2 - n\bar{y}^2}{n-1} \leqq 9.999999999 \times 10^{99}$
	σ_y	$n>0$ $0 \leqq \frac{\Sigma y^2 - n\bar{y}^2}{n} \leqq 9.999999999 \times 10^{99}$
	r	$n \neq 0$ $0 < \lvert(\Sigma x^2 - n\bar{x}^2)\cdot(\Sigma y^2 - n\bar{y}^2)\rvert \leqq 9.999999999 \times 10^{99}$ $\lvert \Sigma xy - \frac{\Sigma x \cdot \Sigma y}{n} \rvert \leqq 9.999999999 \times 10^{99}$ $\left\lvert \frac{\Sigma xy - \frac{\Sigma x \cdot \Sigma y}{n}}{\sqrt{(\Sigma x^2 - n\bar{x}^2)\cdot(\Sigma y^2 - n\bar{y}^2)}} \right\rvert \leqq 9.999999999 \times 10^{99}$
	b	$n \neq 0$ $0 < \lvert\Sigma x^2 - n\bar{x}^2\rvert \leqq 9.999999999 \times 10^{99}$ $\lvert \Sigma xy - \frac{\Sigma x \cdot \Sigma y}{n} \rvert \leqq 9.999999999 \times 10^{99}$ $\left\lvert \frac{\Sigma xy - \frac{\Sigma x \cdot \Sigma y}{n}}{\Sigma x^2 - n\bar{x}} \right\rvert \leqq 9.999999999 \times 10^{99}$
	a	a is the same condition as b and $\lvert\bar{y} - b\bar{x}\rvert \leqq 9.999999999 \times 10^{99}$
	y'	$\lvert a+bx\rvert \leqq 9.999999999 \times 10^{99}$
	x'	$\lvert \frac{y-a}{b} \rvert \leqq 9.999999999 \times 10^{99}$

F. SPECIFICATIONS

Model: EL-735

Type: Business/Financial calculator

Display capacity: Upper line: 12 columns of 5 × 7 dot characters. Lower line: 12 columns of 7-segment characters. Ten digit floating decimal point display or a nine digit mantissa and a two digit exponent. Minus symbol appears both in mantissa and exponents portion.

Internal capacity: Mantissa 12 digits, exponent 2 digits

Functions: Four arithmetic calculations, reciprocal, square root, square and power, logarithmic and exponential, factorial, memory,

statistical, day/date, database and financial calculations.

Display: Liquid crystal display (FEM type)

Component: LSI, etc.

Power supply: 3.0 VDC (0.001W)

Operate time: Approx 800 hours (CR2016) of displaying 55'555. at ambient temperature: 20°C (68°F). The operating time will vary depending on the type of battery and the way the calculator is used.

Operating temperature: 0° — 40°C (32° — 104°F)

Dimensions: 69(W) × 132(D) × 7.8(H) mm
2-23/32(W) × 5-3/16(D) × 5/16(H) inch

Weight: Approx. 69g (0.15 lbs.)

Accessories: Battery (installed), wallet, operation manual

G. BATTERY REPLACEMENT

The EL-735 calculator uses one lithium battery for power. If the indicators and numbers in the display appear dim, it is a sign that the battery is in need of replacement, replace the battery as soon as possible.

Use only a lithium battery of the same type as the one removed from the calculator (CR2016).

Note: When the battery is replaced, the memory contents may be erased. Write down any important stored data before replacing the battery.

TO REPLACE THE BATTERY

1. Press the OFF key to turn the calculator off.

2. Remove the screw from the battery cover on the back of the calculator and remove the cover.

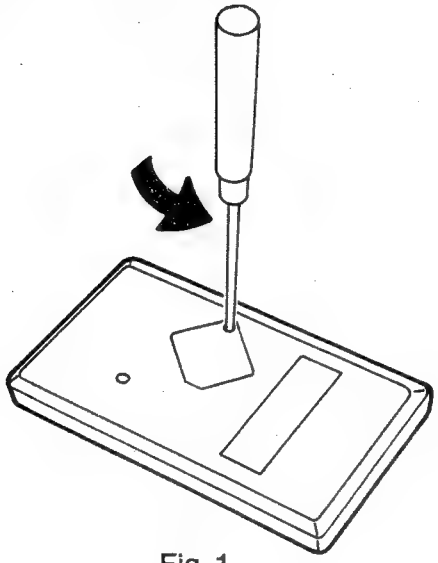


Fig. 1

3. Remove the used battery from the compartment with a pointed device such as a ball-point pen.

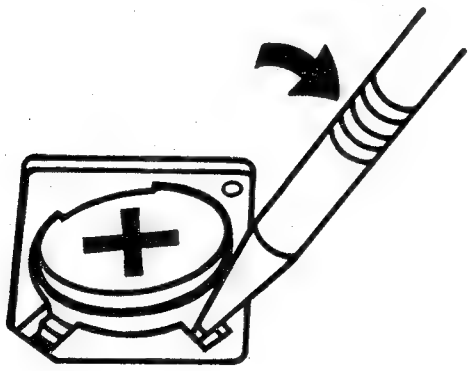


Fig. 2

4. Clean the replacement battery (type CR2016) with a soft dry cloth, then place it in the battery compartment with the positive (+) side facing out.

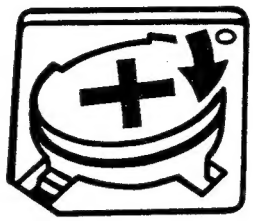


Fig. 3

5. Replace the battery cover and secure it with the screw.

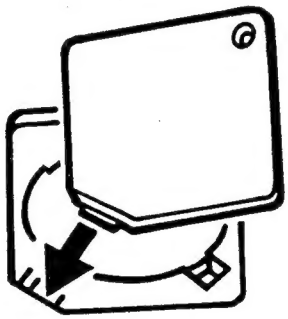


Fig. 4

6. Press the reset switch and verify that the message "CL ALL? ➡ENT" appears in the display. Press [C·CE] to clear the message, or [ENT] to clear all the memory. If this message does not appear, remove the battery and re-install it.

HINTS ON BATTERY USE

- Use only a lithium battery of the same type as the one currently in the calculator (type CR2016).
- When inserting the replacement battery, make sure the positive (+) side of the battery faces out of the calculator.

CAUTIONS

- Keep the battery out of reach of children.
- Dispose of the old battery in a safe place. The battery may explode if disposed of in a fire.
- The original battery was installed before shipment from the factory, so battery life may be shorter than indicated in the specifications.
- To avoid damage by corrosive leakage, remove the battery when it is worn or when the calculator is to be stored for a long period of time.

H. OPERATION NOTES

The liquid crystal display is made of glass material, so handle the calculator with care.

To ensure trouble-free operation of the SHARP EL-735, the following are recommended:

1. The calculator should not be kept in areas subject to moisture, dust and extreme temperature changes (such as car dashboards).
2. A soft, dry cloth should be used to clean the calculator. Do not use solvents or a wet cloth.
3. If the calculator will not be operated for an extended period of time, remove the batteries to avoid possible damage caused by battery leakage.
4. If service should be required on this calculator, use only a SHARP servicing dealer, a SHARP approved service facility, or a SHARP repair service, where available.
5. This model has special soft keys. To avoid scratching the keys, do not push them with hard, sharp objects.
6. Keep this manual for future reference.

I. INDEX